REMARKS

This is in response to the Office Action mailed May 12, 2006.

Claims 1 through 5 and 7 through 64 are currently pending in the application.

Claims 33 through 57 are withdrawn from consideration.

Claims 1 through 5, 7 through 32 and 58 through 63 stand rejected.

35 U.S.C. § 102(e) Anticipation Rejections

Anticipation Rejection Based on U.S. Patent 5,959,363 to Yamada et al.

Claims 58 through 61 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Yamada et al. (U.S. Patent 5,959,363). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Turning to the cited prior art, the Yamada et al. reference describes a semiconductor device comprising a wiring circuit board and a semiconductor chip mounted through a bump electrode on the circuit board, a space between the circuit board and the semiconductor chip as well as a periphery of the semiconductor chip being encapsulated with a resin containing a filler. A passivation film of the semiconductor chip is formed of a polymer film, such as a hydrocarbon wax, a fatty acid type wax, a fatty amide type wax or an ester type wax or resin layer.

Applicant asserts that the Yamada et al. reference does not anticipate the presently claimed invention of independent claim 58 because the Yamada et al. reference does not identically describe each and every element as set forth in the claim, either expressly or inherently described, in as complete detail as is contained in the claim. Applicant asserts that the Yamada et al. reference does not identically describe, either expressly or inherently, the elements of the presently claimed invention of independent claim 52 calling for "applying a liquid wetting

agent layer to one of said active surface of said semiconductor device and said upper surface of said substrate" and "applying a flowable underfill material between the substrate and the semiconductor device, such that said flowable underfill material contacts said applied wetting agent layer ".

In contrast to the elements of the presently claimed invention of independent claim 58, the Yamada et al. reference describes the use of a wax layer. Applicant asserts that Yamada et al. does not describe applying a wetting agent or essentially uniform liquid silane-based wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate whatsoever. Therefore, Yamada et al. al. does not anticipate independent claim 58. Accordingly, presently amended independent claim 58 is allowable as well as the dependent claims 59 through 61 therefrom.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based over the combination of U.S. Patent 5,959,363 to Yamada et al., U.S. Patent 6,350,840 to Schultz et al. and U.S. Patent 4,961,967 to Pluddemann

Claims 1 through 5, 7 through 12, 15, 22, 62 and 64 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Yamada et al. (U.S. Patent 5,959,363), Schultz et al. (U.S. Patent 6,350,840) and Pluddemann (U.S. Patent 4,961,967). Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Turning to the cited prior art, the Yamada et al. reference teaches or suggests a semiconductor device comprising a wiring circuit board and a semiconductor chip mounted through a bump electrode on the circuit board, a space between the circuit board and the semiconductor chip as well as a periphery of the semiconductor chip being encapsulated with a resin containing a filler. A passivation film of the semiconductor chip is formed of a polymer film, such as a hydrocarbon wax, a fatty acid type wax, a fatty amide type wax or an ester type wax or resin layer. The Yamada et al. reference solely teaches or suggests that "[t]he encapsulation resin should preferably be a thermosetting resin of non-solvent type in general, but the resin is not limited to a bisphenol type epoxy resin." Also, the Yamada et al. reference teaches or suggests that the ". . . resin comprises a first resin and a second resin . . . ." A first resin and a second resin does not teach or suggest any resin but a thermosetting resin, the sole type of resin in the Yamada et al.resin specification.

The Schultz reference teaches or suggests the use of a thermoplastic material for an encapsulant.

The Plueddemann reference teaches or suggests a primer composition for improving adhesion between a solid substrate and a thermo-plastic resin. The composition consists essentially of 1 to 25 weight percent of an organosilicon compound selected from a group of silane compounds or partial hydrolyzates thereof and 75 to 99 weight percent of an alkoxymethylitriazine. Plueddemann teaches an improved wet and dry adhesion of thermoplastics to solid substrates. All the examples of the Plueddeman reference, Examples 1 through 7, illustrate the use of a primer composition with a thermo-plastic material, not a thermo-setting material. The primer compound of Plueddemann is not directed to an improved flow of an underfill material that is a thermo-setting material. Applicant asserts that an underfill material is clearly a thermo-setting material, not a thermo-plastic material. In contrast to a thermo-setting material, a thermo-plastic material is a material capable of being repeatedly softened by an increase of temperature and hardened by a decrease in temperature. A thermo-plastic material substantially physically changes upon heating rather than having a chemical change so that in the softened stage the thermo-plastic material can be shaped by flow into articles by molding or extrusion. Thermo-plastic materials are too viscous to be used as underfill materials because the

high viscosity of the thermo-plastic material prevents the material from flowing into small spaces, such as the 125 microns or less space between a IC chip mounted by solder balls on an IC chip carrier. The Plueddeman reference is solely and only directed to the use of a primer composition with thermo-plastic materials, not thermo-setting materials, such as underfill. Applicant asserts that there is no reference to thermo-setting materials in the Plueddeman reference whatsoever.

Applicant asserts that any combination of the Yamada et al. reference, the Schulz et al. reference, and the Plueddeman reference fails to teach or suggest the claim limitations of independent claims 1, 10, 62 and 64 calling for "applying a liquid wetting agent layer to one of said surface of said semiconductor device and said surface of said substrate", "applying a flowable underfill material between the substrate and the semiconductor device, such that said flowable material contacts said liquid wetting agent layer", "applying a liquid wetting agent layer to one of said active surface of said semiconductor device and said upper surface of said substrate", "applying a liquid wetting agent layer to one of said active surface of said semiconductor device and said upper surface of said substrate", "applying a silane-based material layer to one of a portion of said active surface of said semiconductor device and a portion of said upper surface of said substrate", "applying a flowable underfill material between said semiconductor device and said substrate, such that said flowable underfill material contacts said applied silane-based material layer", "applying a essentially uniform liquid wetting agent layer having a thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate", "applying a flowable underfill material between the substrate and the semiconductor device separately from said liquid wetting agent layer, such that said flowable material contacts said wetting agent layer", "applying a essentially uniform liquid silane-based wetting agent layer having a total thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate" and "applying a flowable underfill material between the substrate and the semiconductor device separately from said liquid silane-based wetting agent layer, such that said flowable material contacts said wetting agent layer".

Applicant asserts that the Yamada et al. reference clearly uses a thermo-setting material as an underfill material because the Yamada teaches or suggests thermo-setting resin.

Applicant further asserts that the Yamada et al. reference cannot teach or suggest the use of a thermo-plastic underfill because a thermo-plastic underfill would soften with an increase of temperature when the IC chip is being operated so that the thermo-plastic underfill would be unable to compensate for any thermal mismatch between IC chip and the IC carrier thereby making the Yamada et al. invention inoperable due to the thermo-plastic material loosing its strength as it is heated thereby allowing the IC chip to separate from the substrate as the bump electrodes 203 fail in shear due to the thermo-plastic material carrying no load. Additionally, thermo-plastic materials have too high viscosity to be used as underfill materials as they are unable to effectively fill the small space between an IC chip mounted on an IC chip carrier using solder balls where the small space is 125 microns or less in height.

Applicant also asserts that the Schultz reference solely teaches or suggests the use of a thermoplastic material for an encapsulant.

Applicant yet further asserts that the Plueddeman reference is solely and only directed to the use of a primer composition with thermo-plastic materials, not thermo-setting materials, such as underfill. Applicant asserts that there is no reference to thermo-setting materials in the Plueddeman reference whatsoever.

Applicant asserts that both the Schulz et al. reference and the Plueddeman reference teaches away from any combination with and modification of the Yamada et al. reference. Yet further, Applicant asserts that one of ordinary skill in the art would not substitute the use of a thermo-plastic for the thermo-setting underfill of Yamada et al. Applicant asserts the one of ordinary skill in the art would not substitute either the thermo-plastic resin of the Schultz et al. reference or the liquid primer composition from the Plueddeman reference to be separately applied to the IC chip and/or IC carrier of the Yamada et al. reference. The substitution of a thermo-plastic resin of Schultz et al. for a thermo-setting resin of Yamada et al. destroys the Yamada et al. invention as it would fail since in operation, the thermoplastic resin of Schultz et al. would allow the device to separate and the bump electrodes 203 fail in shear due to the thermo-plastic resin carrying no load. Further, Applicant asserts that the substitution of a liquid

primer composition from the Plueddeman reference for a resin of the Yamada et al. reference cannot be the substitution of an equivalent. Applicant asserts that one of ordinary skill in the art would not use a liquid primer composition used with thermo-plastic resins for use with thermo-setting plastics of Yamada et al.

Therefore, Applicant asserts that any combination of the Yamada et al. reference, the Schultz et al. reference and the Plueddeman reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of independent claims 1, 10, 62 and 64 as well as the dependent claims therefrom. Accordingly, independent claims 1, 10, 62, and 64 are allowable as well as the dependent claims therefrom.

Applicant asserts that the sole teaching or suggestion for the use of a liquid wetting agent on one of the active surface of said semiconductor device and a portion of said upper surface of said substrate for use with an underfill material is solely the Applicant's disclosure because the cited prior art teaches away from any combination thereof, because if the prior art is combined as suggested in the rejection, the combination clearly destroys the operability of the primary reference and because the cited prior art does not contain any suggestion for any combination thereof. Solely Applicant's disclosure contains any such suggestion as evidenced by the attempt to combine the cited prior art in a rejection which destroys the invention of the Yamada et al. reference.

Therefore, Applicant asserts that any combination of the Yamada et al. reference, the Schultz et al. reference, and the Plueddeman reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of presently amended independent claims 1, 10, 62 and 64 as well as the dependent claims therefrom. Accordingly, independent claims 1, 10, 62, and 64 are allowable as well as the dependent claims therefrom.

Obviousness Rejection Based on U.S. Patent 5,959,363 to Yamada et al., U.S. Patent 6,350,840 to Schultz et al. and U.S. Patent 4,961,967 to Pluddemann as applied to claim 64 supra, and further in combination of U.S. Patent 6,303,277 to Hieda et al.

In the alternative, claim 64 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada et al. (U.S. Patent 5,959,363), Schultz et al. (U.S. Patent 6,350,840) and Pluddemann (U.S. Patent 4,961,967) as applied to claim 64 supra, and further in combination with Hieda et al. (U.S. Patent 6,303,277). Applicant respectfully traverses this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

Turning to the cited prior art, the Yamada et al. reference teaches or suggests a semiconductor device comprising a wiring circuit board and a semiconductor chip mounted through a bump electrode on the circuit board, a space between the circuit board and the semiconductor chip as well as a periphery of the semiconductor chip being encapsulated with a resin containing a filler. A passivation film of the semiconductor chip is formed of a polymer film, such as a hydrocarbon wax, a fatty acid type wax, a fatty amide type wax or an ester type wax or resin layer. The Yamada et al. reference solely teaches or suggests that "[t]he encapsulation resin should preferably be a thermosetting resin of non-solvent type in general, but the resin is not limited to a bisphenol type epoxy resin." Also, the Yamada et al. reference teaches or suggests that the ". . . resin comprises a first resin and a second resin . . . ." A

first resin and a second resin does not teach or suggest any resin but a thermosetting resin, the sole type of resin in the Yamada et al.resin specification.

The Schultz reference teaches or suggests the use of a thermoplastic material for an encapsulant.

The Plueddemann reference teaches or suggests a primer composition for improving adhesion between a solid substrate and a thermo-plastic resin. The composition consists essentially of 1 to 25 weight percent of an organosilicon compound selected from a group of silane compounds or partial hydrolyzates thereof and 75 to 99 weight percent of an alkoxymethylitriazine. Plueddemann teaches an improved wet and dry adhesion of thermoplastics to solid substrates. All the examples of the Plueddeman reference, Examples 1 through 7, illustrate the use of a primer composition with a thermo-plastic material, not a thermo-setting material. The primer compound of Plueddemann is not directed to an improved flow of an underfill material that is a thermo-setting material. Applicant asserts that an underfill material is clearly a thermo-setting material, not a thermo-plastic material. In contrast to a thermo-setting material, a thermo-plastic material is a material capable of being repeatedly softened by an increase of temperature and hardened by a decrease in temperature. A thermo-plastic material substantially physically changes upon heating rather than having a chemical change so that in the softened stage the thermo-plastic material can be shaped by flow into articles by molding or extrusion. Thermo-plastic materials are too viscous to be used as underfill materials because the high viscosity of the thermo-plastic material prevents the material from flowing into small spaces, such as the 125 microns or less space between a IC chip mounted by solder balls on an IC chip carrier. The Plueddeman reference is solely and only directed to the use of a primer composition with thermo-plastic materials, not thermo-setting materials, such as underfill. Applicant asserts that there is no reference to thermo-setting materials in the Plueddeman reference whatsoever.

The Hieda reference teaches or suggests the use of a monomolecular film or a monoatomic film of an alkane thiol.

Applicant asserts that any combination of the Yamada et al. reference, the Schulz et al. reference, the Plueddeman reference and the Hieda et al. reference fails to teach or suggest the

claim limitations of independent claim 64 calling for "applying a essentially uniform liquid silane-based wetting agent layer having a total thickness of about a monolayer to at least one of said surface of said semiconductor device and said surface of said substrate" and "applying a flowable underfill material between the substrate and the semiconductor device separately from said liquid silane-based wetting agent layer, such that said flowable material contacts said wetting agent layer".

Applicant asserts that the Yamada et al. reference clearly uses a thermo-setting material as an underfill material because the Yamada teaches or suggests thermo-setting resin.

Applicant further asserts that the Yamada et al. reference cannot teach or suggest the use of a thermo-plastic underfill because a thermo-plastic underfill would soften with an increase of temperature when the IC chip is being operated so that the thermo-plastic underfill would be unable to compensate for any thermal mismatch between IC chip and the IC carrier thereby making the Yamada et al. invention inoperable due to the thermo-plastic material loosing its strength as it is heated thereby allowing the IC chip to separate from the substrate as the bump electrodes 203 fail in shear due to the thermo-plastic material carrying no load. Additionally, thermo-plastic materials have too high viscosity to be used as underfill materials as they are unable to effectively fill the small space between an IC chip mounted on an IC chip carrier using solder balls where the small space is 125 microns or less in height. Further, in contrast to the elements of the presently claimed invention of independent claim 64, the Yamada et al. reference describes the use of a wax layer or resin layer while the Hieda et al. reference uses an alkane thiol layer.

Applicant also asserts that the Schultz reference solely teaches or suggests the use of a thermoplastic material for an encapsulant.

Applicant yet further asserts that the Plueddeman reference is solely and only directed to the use of a primer composition with thermo-plastic materials, not thermo-setting materials, such as underfill. Applicant asserts that there is no reference to thermo-setting materials in the Plueddeman reference whatsoever.

Applicant asserts that both the Schulz et al. reference and the Plueddeman reference teaches away from any combination with and modification of the Yamada et al. reference. Yet

further, Applicant asserts that one of ordinary skill in the art would not substitute the use of a thermo-plastic for the thermo-setting underfill of Yamada et al. Applicant asserts the one of ordinary skill in the art would not substitute either the thermo-plastic resin of the Schultz et al. reference or the liquid primer composition from the Plueddeman reference to be separately applied to the IC chip and/or IC carrier of the Yamada et al. reference. The substitution of a thermo-plastic resin of Schultz et al. for a thermo-setting resin of Yamada et al. destroys the Yamada et al. invention as it would fail since in operation, the thermoplastic resin of Schultz et al. would allow the device to separate and the bump electrodes 203 fail in shear due to the thermo-plastic resin carrying no load. Further, Applicant asserts that the substitution of a liquid primer composition from the Plueddeman reference for a resin of the Yamada et al. reference cannot be the substitution of an equivalent. Applicant asserts that one of ordinary skill in the art would not use a liquid primer composition used with thermo-plastic resins for use with thermo-setting plastics of Yamada et al.

Therefore, Applicant asserts that any combination of the Yamada et al. reference, the Schultz et al. reference, the Plueddeman reference, and the Hieda et al. reference cannot and does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of independent claim 64. Accordingly, independent claim 64 is allowable.

Applicant asserts that the sole teaching or suggestion for the use of a liquid wetting agent on one of the active surface of said semiconductor device and a portion of said upper surface of said substrate for use with an underfill material is solely the Applicant's disclosure because the cited prior art teaches away from any combination thereof, because if the prior art is combined as suggested in the rejection, the combination clearly destroys the operability of the primary reference and because the cited prior art does not contain any suggestion for any combination thereof. Solely Applicant's disclosure contains any such suggestion as evidenced by the attempt to combine the cited prior art in a rejection which destroys the invention of the Yamada et al. reference.

Therefore, Applicant asserts that any combination of the Yamada et al. reference, the Schultz et al. reference, the Plueddeman reference, and the Hieda et al. reference cannot and does

not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the presently claimed inventions of independent claim64. Accordingly, independent claim 64 is allowable.

Obviousness Rejection Based on U.S. Patent No. 5,959,363 to Yamada et al., as applied to claim 61, and further in combination with U.S. Patent 6,350,840 to Schultz et al. and U.S. Patent 4,961,967 to Pluddemann.

Claim 63 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada et al. (U.S. Patent 5,959,363) as applied to claim 61, and further in combination with Schultz et al. (U.S. Patent 6,350,840) and Pluddemann (U.S. Patent 4,961,967). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that dependent claim 63 is allowable over the cited prior art for the same reasons that independent claim 62 is allowable from which it depends.

Obviousness Rejection Based on U.S. Patent No. 5,959,363 to Yamada et al., U.S. Patent 6,350,840 to Schultz et al. and U.S. Patent 4,961,967 to Pluddemann as applied to claim 10, and further in combination with U.S. Patent 5,776,982 to Akram et al.

Claims 13, 14, 16 through 21 and 23 through 30 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada et al. (U.S. Patent 5,959,363), Schultz et al. (U.S. Patent 6,350,840) and Pluddemann (U.S. Patent 4,961,967) as applied to claim 10, and further in combination with Akram et al. (U.S. Patent 5,776,982) Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that such dependent claims are allowable as they depend from allowable independent claim 10 for the reasons set forth hereinabove.

Obviousness Rejection Based on U.S. Patent 5,959,363 to Yamada et al., U.S. Patent 6,350,840 to Schultz et al. and U.S. Patent 4,961,967 to Pluddemann as applied to claim 10, and further in combination with U.S. Patent 5,203,076 to Banerji et al.

Claims 31 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada et al. (U.S. Patent 5,959,363), Schultz et al. (U.S. Patent 6,350,840) and Pluddemann

(U.S. Patent 4,961,967) as applied to claim 10, and further in combination with Banerji et al. (U.S. Patent 5,203,076). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant asserts that such dependent claims are allowable as they depend from allowable independent claim 10 for the reasons set forth hereinabove.

CONCLUSION

Claims 1 through 5 and 7 through 64 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicant's undersigned attorney.

Respectfully submitted,

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